

3.—UPPER DEVONIAN CORALS FROM WESTERN AUSTRALIA.

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With one plate and eight text figures.

INTRODUCTION.

This paper revises those species of corals already described from Western Australia, adds some new species, indicates that with one exception the age of the coralliferous beds is probably Frasnian (*i.e.*, the lower part of the Upper Devonian), and describes the arrangement of the calcareous fibres in the Tabulate genera *Alveolites* Lamarek and *Syringopora* Goldfuss.

The Rugose Corals here described belong with one exception to the group of corals related to *Disphyllum* de Fromentel, a group recently studied by Lang and Smith (1935). The group is characteristic of the Devonian of Europe and America; it is important in the Middle Devonian, and dominant in the Upper Devonian, and it is but natural that the earliest collections of Rugose Corals from the Upper Devonian of Western Australia should consist almost entirely of its representatives. The Tabulate corals described here also belong to genera dominant in the European Upper Devonian.

The specimens are from collections made by E. T. Hardman in 1880, H. P. Woodward in 1906, A. Wade in 1920 and J. E. Wells in 1922, and are in the British Museum (Catalogue Letters B.M.R.), the Geological Survey of Western Australia (Catalogue Numbers beginning 100.....), the Perth Museum (Catalogue Letter  $\Delta$ ), and the University of Western Australia (Catalogue Number.....).

The localities and the species found at each are shown in the accompanying table:—

|   | Price's Ck., Rough Range, Kimberley. | Price's Ck., Rough Range, Kimberley (N. of Borehole). | Opp. Mt. Krauss, Rough Range, Kimberley. | Barker Gorge, Napier Range, Kimberley. | Gascoyne R. (locality challenged). | Mt. Pierre, Kimberley. (Famennian). |
|---|--------------------------------------|---|--|--|------------------------------------|-------------------------------------|
| " <i>Cystiphyllum</i> " <i>kimberleyense</i> sp. nov. | ...                                  | ...   | ...                                      | ...                                    | ...                                | ×                                   |
| <i>Disphyllum depressum</i> (Hinde) ...               | ...                                  | ×   | ×  | ...                                    | ×                                  |                                     |
| <i>D. virgatum</i> (Hinde) ...                        | ...                                  | ...   | ×  | ...                                    | ×                                  |                                     |
| <i>Phillipsastraea delicatula</i> sp. nov. ...        | ...                                  | ...   | ...                                      | ×                                      |                                    |                                     |
| <i>Prismatophyllum brevilamellatum</i> sp. nov.       | ×                                    |   |  |  |                                    |                                     |
| <i>Alveolites</i> aff. <i>multi perforatus</i> Salée  | ...                                  | ...   | ?  | ...                                    | ?                                  |                                     |
| <i>A. tumida</i> (Hinde) ...                          | ...                                  | ...   | ×  |  |                                    |                                     |
| <i>Aulopora repens</i> Knorr & Walch; Hinde           | ...                                  | ...   | ×  |  |                                    |                                     |
| <i>Syringopora patula</i> Hinde ...                   | ...                                  | ...   | ...                                      | ...                                    | ×                                  |                                     |

Of these species, "*Cystiphyllum*" *kimberleyense* was collected from the red Goniatic limestone of Mt. Pierre, shown by Delépine (1935) to be Famennian. Of the others, *D. virgatum* is close to *D. aequisseptatum* Edwards



and Haime from the Upper Givetian or Lower Frasnian of Ilfracombe. *D. depressum* is close to *D. goldfussi* (Geinitz), from the Givetian and Frasnian of Europe. *P. brevilamellatum* is unlike any of the described forms of this genus, which is characteristic of the Middle and Upper Devonian of Europe and America. *P. delicatula* is like the Upper Devonian *P. hennahi* Edwards and Haime. *Syringopora patula* is comparable with the Givetian *S. caespitosa* Goldfuss. *A. tumida* may possibly be related to the Upper Middle Devonian genus *Plagiopora* Gurich. *A. multiperforatus* is a characteristic Frasnian coral. *A. repens* ranges through Eifelian, Givetian and Frasnian.

The ages of the coralliferous localities which these species indicate are as follows. "Opposite Mt. Krauss" (where also, for reasons given in the next paragraph, the specimens said to be from the Gascoyne River are believed to have been collected) is either Upper Givetian or Lower Frasnian, and the absence of all the cyathophylloid genera so characteristic of the Middle Devonian makes a Lower Frasnian horizon more likely. The cream-coloured limestone from Price's Creek north of the Bore-hole is also probably Lower Frasnian. The white crystalline limestone of Price's Creek is either Middle or Upper Devonian, and the only coral species collected from there might well be Frasnian. The Barker Gorge limestone is Upper Devonian, and probably Frasnian.

I doubt that the specimens of *D. virgatum*, *D. depressum*, *S. patula*, and *A. aff. multiperforatus* from the Hardman collection, labelled as from the Gascoyne River, actually came from this locality. So far as I can discover from David's Geological Map of Australia, there is no outcrop of Devonian rocks along the Gascoyne River. The "Gascoyne" specimens of *D. virgatum* and *D. depressum* are identical in matrix and preservation with those from opposite Mt. Krauss, even to the crushing of *D. virgatum*. *D. depressum* "from Gascoyne River" is encrusted with *Stromatoporella eifeliensis*, known from opposite Mt. Krauss. The lower half of the holotype of *D. depressum* is labelled as from opposite Mt. Krauss, and the calical half is labelled "Gascoyne River." In this case there is proof that the labels have been mixed; and I think that probably all the corals mentioned in this paper as from the Gascoyne River were really collected opposite Mt. Krauss. No Devonian brachiopods were described from the Gascoyne River in the series of articles on Western Australian Palaeontology which accompanied Hinde's paper on the corals. *Amplexus pustulosus* and *Pterophyllum australe*, described by Hinde as from the Gascoyne River, are Permian corals, and are probably correctly labelled.

The relations of the Kimberley Upper Palaeozoic limestones (Wade, 1923-24; Hosking, 1933) may be summarised as follows:—

PERMO-CARBONIFEROUS sandstones with tillites  
unconformity

LOWER CARBONIFEROUS Upper grey limestones (Wade) 600 feet +

FAMENNIAN Red goniatite limestone of Mt. Pierre (Wade) with "*Cystiphyllum*" *kimberleyense*, 200 ft. +  
Smith, 1933.

FRASNIAN

All other  
coral  
localities  
mentioned  
in this  
paper.

(a) White or cream-coloured *Atrypa* limestone, with *Pugnax pugnax*, *Wilsonia cuboides* and *Spirifer* cf. *disjuncta*, of Margaret River - Christmas Creek area.

(b) White crystalline limestone of Price's Creek.

(c) Red and red-white limestone of Barker Gap.

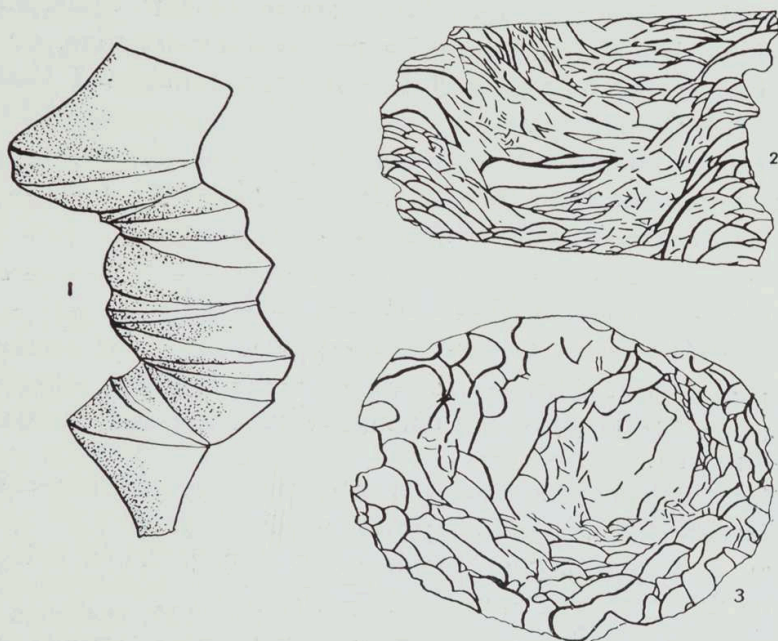
The relations of a, b, c to one another are not known.



## DESCRIPTION OF CORALS.

“*Cystiphyllum*” *kimberleyense* sp. nov.

(Text figures 1-3.)

*Cystiphyllum* sp. Wade, 1924, p. 13.*Holotype*. B.M.R. 29066, Upper Devonian (Famennian), Mt. Pierre, Kimberley. This is the only specimen examined.*Diagnosis*.—Simple Rugose coral of irregular growth, with large dissepiments, flat or sagging tabulae and no septa or vestiges of septa.*Description*.—The corallum is simple, 45 mm. tall, with a maximum diameter of 20 mm. The apical portion is trochoid, but after attaining a height of 10 mm. the corallum becomes very irregular in diameter and in direction of growth. Rejuvenescence of the type causing gradual decrease in diameter of the corallum, alternates with periods of normal growth, each segment differing from the preceding in direction. (Text fig. 1.) The calice is not known. The epitheca is rugose, and does not show longitudinal striation.Text-figs. 1-3. “*Cystiphyllum*” *kimberleyense* sp. nov.B.M.R. 29066. *Holotype*.

1. Diagram of corallum (natural size).

2. Median vertical section. x 2. B.M.R. 31072.

3. Transverse section. x 2. B.M.R. 31071.

No septa or vestiges of septa are present. The dissepiments are large plates convex distally, and slope gently down towards the tabularium, which occupies half the width of the corallum, and has flat, complete, and closely placed tabulae. The skeletal tissue is damaged by crushing. The vertical section is not unlike that of *Omphyra*.

*Remarks*.—Pending a revision of the cystiphylloid corals of the Devonian, this species is temporarily referred to *Cystiphyllum* Lonsdale, which is a Silurian genus. The Devonian cystiphylloids are unrelated homeomorphs.

## DISPHYLLUM.

*Disphyllum* de Fromentel, 1861, p. 303.*Disphyllum* Lang and Smith, 1934, p. 80; 1935, p. 544.

*Genolectotype*: *Disphyllum goldfussi* (Geinitz), of which the lectotype is *Cyathophyllum caespitosum* Goldfuss, 1926, p. 60, Pl. XIX., fig. 2b only, see Lang and Smith *Loc cit*.



*Diagnosis.*—"Phaceloid Rugose corals in which increase may be lateral or calicular; the septa rarely reach the axis, but are usually long, and typically thin; the tabulae are sometimes complete, though generally incomplete and differentiated into a transverse axial, and an inclined periaxial, series; with dissepiments typically small, strongly arched, sometimes of one, but frequently of two, kinds: an inner, single series of globose, distally directed dissepiments, and an outer series of flat or arched dissepiments." Lang and Smith, 1935, p. 545.

*Remarks.*—This very variable genus is widespread in the Middle and Upper Devonian. It has recently been described and analysed by Lang and Smith, 1935, together with its genomorph (*Phacellophyllum*) Gurich, and the related genera *Prismatophyllum* Simpson, *Phillipsastraea* d'Orbigny and *Macgeea* Webster. The group possesses distinctive horizontal skeletal elements. In what is probably the fundamental arrangement, the tabulae are complete and flat or sagging, and the dissepiments are more or less globose. In some members of the group a single vertical series of horse-shoe dissepiments may be differentiated, with series of globose and highly inclined dissepiments on either side, or with a series of flat dissepiments on the peripheral side. The tabulae may be replaced by tabellae, or be differentiated into two series. Lang and Smith have considered that those Disphyllids in which the dissepiments consist of a single series of flat plates and a single series of horse-shoe plates, and in which the tabulae are in two series, form a genomorphic group, (*Phacellophyllum*) Gurich. The West Australian forms are typical *Disphyllum*.

### ***Disphyllum depressum* (Hinde)**

(Plate I., figs. 4-8).

*Cyathophyllum depressum* Hinde, 1890, p. 195, Pl. viii., figs. 2a, 2b, from the Devonian opposite Mt. Krauss, Kimberley District; and the Gascoyne River [locality challenged].

*Cyathophyllum depressum* Hinde; Glauert, 1910, pp. 78, 82; 1925, p. 41.

*Cyathophyllum depressum* Hinde; Hosking, 1933, p. 68.

*Syntypes:* R. 2269 with figured slide R. 13981 (fig. 2b) in British Museum is the upper part of 10039 in the Western Australian Geological Survey Collection. The label for 10039 reads Gascoyne River, but the B.M. specimen is said to be from opposite Mt. Krauss, Kimberley District, W.A. This latter is probably right. (Plate I., figs 6 and 7.)

R. 13982, opposite Mt. Krauss, Kimberley. A vertical section has been cut from the apical part of this. (Plate I., figs. 4 and 5.)

R. 2270, Gascoyne River, encrusted with *Stromatoporella eifeliensis* Nicholson.

*Lectotype:* (here chosen) R. 2269, with slide R. 13981 in British Museum, and its lower part 10039 in the Geological Survey of Western Australia Collection, from the Devonian (Frasnian, or ? Givetian) opposite Mt. Krauss, Kimberley District, W.A. (Plate I., figs 6 and 7).

*Other specimens:* 2753, 2754, in the Collection of the University of Western Australia, from the Devonian (Frasnian, or possibly Givetian) of Price's Creek, north of bore, Rough Range, Kimberley; (Plate I., fig. 8).

*Diagnosis.*—Dendroid *Disphyllum* with trochoid corallites; and with dissepimentarium forming an almost complete peripheral stereozone.

*Description.*—The corallum is dendroid, offsets arising by lateral increase. The individual corallites are trochoid, and erect or slightly curved, attaining an average diameter of 15 mm., in a length of 20 mm. The largest corallite had a diameter of 16 mm. Calical and epithecal characters were not observed.



The septa are of 2 series, about 26 of each. They are neither wavy nor carinate. The major septa may extend to the axis, where their axial ends rotate slightly, but typically they leave an axial space devoid of septa. They are dilated and usually in contact with the dilated minor septa in the dissepimentarium, thus forming a wide stereozone, but in the tabularium they are attenuate. The minor septa are one-third to one-half as long as the major septa. In some specimens dilatation is confined to those parts of the septa at the periphery and at the inner border of the dissepimentarium, so that the transverse sections resemble *D. virgatum*. The septa consist of compound trabeculae, laterally contiguous, but unfortunately the preservation of the material is not good enough to allow detailed description.

The dissepiments are small, globose and distally convex, and are not often seen, being developed only where interseptal loculi are left between the dilated septa. The tabulae are in two series, an outer series of steeply inclined plates, and an inner series which are usually complete, and may be either domed or horizontal. The tabulae are not dilated.

*Remarks.*—The holotype shows a less perfectly developed stereozone than the other specimens. The species is easily separable from *D. virgatum*, which occurs at the same horizon and locality, by the trochoid shape of the hystero-corallites. Except for its trochoid hystero-corallites and the great dilatation of its septa, *D. depressum* resembles *D. goldfussi* (Geinitz) the type of the genus, which is common in the Givetian and Frasnian of Europe.

### ***Disphyllum virgatum* (Hinde).**

(Plate I., figs. 1-3.)

*Cyathophyllum virgatum* Hinde, 1890, p. 194, Pl. viii., figs. 1a, 1b, from the Devonian opposite Mt. Krauss, Kimberley District; and the Gascoyne River [?].

*Cyathophyllum virgatum* Hinde; Glauert, 1910, pp. 78-82; 1925, p. 41.

*Cyathophyllum virgatum* Hinde; Hosking, 1933, p. 68.

*Syntypes*: R. 2268, R. 13980, British Museum, and  $\Delta$  4, Western Australian Museum, from the Frasnian (or ? Givetian) opposite Mt. Krauss, Kimberley. R. 2272, British Museum and 10038, Geological Survey of Western Australia, Gascoyne River (locality challenged, see introduction).

*Lectotype* (here chosen). B.M.R. 2268, figured Hinde pl. 8, fig. 1, and our Plate I., fig. 1.

*Diagnosis.*—Large *Disphyllum* with globose dissepiments, with sagging tabulae replaced by tabellae, and with stereozones at the inner and outer margins of the dissepimentarium.

*Description.*—The corallum is probably phaceloid, but only fragments of corallites are known; these are cylindrical, and straight or gently curved, the largest being 7 cm. in length, by about 11 mm. in average diameter. The maximum diameter observed was 15 mm. They are all somewhat crushed. The type of increase of the corallum, and the nature of the calice are not known. The epitheca is weathered off. There are 50-56 septa arranged in two series. They are dilated in the dissepimentarium, where there are two zones of greatest thickening—at the epitheca, and at the innermost series of dissepiments, so that two stereozones are formed which may merge in places. They are neither waved nor carinate, and recrystallisation has masked their structure. The minor septa are only one-third to one-half as long as the major septa, which may extend to the axis, but usually are slightly withdrawn from it.

The dissepiments are small and globose, distally convex near the epitheca, but steeply inclined near the tabularium, developed in two, three, or even four series, dilated at the epitheca and near the tabularium.



The tabulae are represented by tabellae, varying in size, but larger than the dissepiments. The axial tabellae are convex distally; those near the dissepiments are steeply inclined, but not regularly enough developed to form a distinct periaxial series. The tabulae which they replace are sagging.

*Remarks.*—There can be little doubt that the fragmentary corallites found are parts of phaceloid coralla. They are close to *D. aequiseptatum* Edwards and Haime from the Lower Frasnian or Upper Givetian of Ilfracombe, showing the replacement of tabulae by tabellae characteristic of the latter, but having septa less withdrawn from the axis.

### PHILLIPSASTRAEA.

*Phillipsastraea* d'Orbigny, 1849, p. 12.

*Phillipsastraea* Lang and Smith, 1935, p. 556.

*Genolectotype*: *Astraea hennahi* Lonsdale; see Edwards and Haime, 1850, p. lxxi.

*Diagnosis.*—"Plocoid or sub-cerioid Rugose corals . . . . . Typically, the septa are dilated at the margin of the tabularium, and there the minor septa terminate, though the major septa may extend to the axis. They are usually carinate, sometimes very strongly so. There is no columella, and the tabulae are transverse, but may be complete or incomplete. Dissepimental tissue is strongly developed, and the dissepiments forming the wall of the tabularium are often smaller and more globose than the rest, corresponding to the horse-shoe shaped dissepiments of *Disphyllum* (*Phacellophyllum*), *Macgeea*, and other allied genera." Lang and Smith, 1935, p. 556.

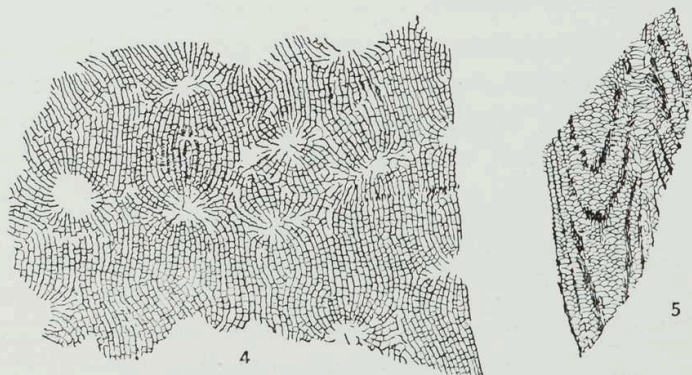
*Remarks.*—The genus is highly characteristic of the Upper Devonian, and is very widespread.

### *Phillipsastraea delicatula* sp. nov.

(Text figures 4 and 5.)

*Holotype*: F. 326 [catalogued as F. 328] = 6924 in the collection of the Geological Survey of Western Australia (text-fig. 4); mentioned Glauert, 1910, pp. 78, 112; 1925, p. 41; and Hosking, 1933, p. 68; Barker Gorge, Napier Range, Kimberley, Upper Devonian. Other specimens are W.A. Museum Nos. 4435-6, Coll. J. E. Wells 1922, mentioned Hosking 1933, p. 69, from the same locality.

*Diagnosis.*—Thamnastraeoid *Phillipsastraea* of extremely fine texture, with no horse-shoe dissepiments.



Text-figs. 4-5. *Phillipsastraea delicatula* sp. nov.

4. Transverse section.  $\times 2$ . 6924, Geol. Surv. W.A. Holotype.

5. Median vertical section.  $\times 2$ . 4435, W.A. Museum.

*Description.*—The corallum is spreading, the holotype being  $4\frac{1}{2} \times 3\frac{1}{2}$  inches  $\times 1\frac{1}{4}$  inch tall, and thamnastraeoid, the septa of neighbouring coral-



lites being confluent and arranged between the individual tabularia like lines of force between poles in a magnetic field. The distance between tabularia varies between 4 mm. and 15 mm., and each tabularium is about 2 mm. in diameter. There are 30 to 40 septa in each corallite. They are attenuated, and waved in short waves parallel to their upper edges; thin trabeculae form noticeable carinae. They are not dilated at the wall of the tabularium. The interseptal loculi are only 0.25 mm. wide. The minor septa are of unequal lengths and extend into the tabularium, sometimes almost to the axis. The tabulae are transverse, about 0.25 mm. apart, and usually complete; they may be gently bowed or sagging. The dissepiments are very small and crowded. Those near the tabularia are steeply inclined, but the inclination decreases towards the line of junction with a neighbouring corallite, where they are horizontal and rather longer.

*Remarks.*—Only three specimens are known. In its delicacy of structure the species approaches the genotype, *P. hennahi* (Lonsdale), and *P. verneuili* Edwards and Haime, from which it differs in the absence of any dilation of the septa at the tabularium, and in the more irregular spacing of the tabularia. It indicates an Upper Devonian horizon.

#### PRISMATOPHYLLUM.

*Prismatophyllum* Simpson, 1900, p. 218.

*Prismatophyllum* Lang and Smith, 1935, p. 558.

*Genotype:* *Prismatophyllum prisma* = *Cyathophyllum rugosum* (Hall), Edwards and Haime, p. 387, pl. xii., figs. 1, 1a-b only, (Lower Middle) Devonian, [Onondaga ("Jeffersonville")] Limestone, Falls of Ohio, etc. The specimen figured by Edwards and Haime was named by Simpson as genotype, who pointed out that it was not conspecific with *Astraea rugosum* Hall, 1843, Lang and Smith, 1935, p. 558.

*Diagnosis.*—"Cerioid Rugose corals with septa which may, or may not, reach the axis; tabulae typically differentiated into a horizontally disposed axial series and an axially inclined periaxial series: and typically numerous, small, globose, dissepiments." Lang and Smith, 1935.

*Remarks.*—Lang and Smith, 1935, p. 559, state that "the genus is widespread and very typical of the Middle and Upper Devonian rocks. The type species agrees in internal structures with *Disphyllum goldfussi*, but is cerioid. The septa are often more or less dilated peripherally, attenuated axially, and are typically, though not always, carinate. The dissepiments are fine and globose . . . . The species vary in their internal structure, from forms with transverse tabulae all of one kind, to others, more typical . . . . with two . . . . In some forms the major septa not only reach the axis, but become more or less involved with each other; in others, they are very short, and alternate with the minor septa at the border of the tabularium."

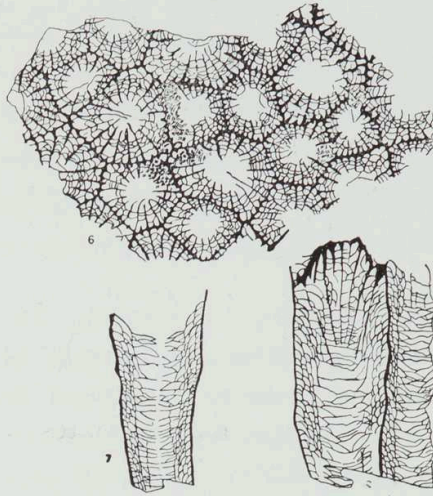
The genus passes into *Phillipsastraea* on the one hand, and *Disphyllum* on the other.



***Prismatophyllum brevilamellatum* sp. nov.**

(Text-figures 6-8.)

*Holotype*: No. 2515, University of Western Australia; a fragment  $2\frac{1}{2} \times 1\frac{1}{2}$  inches in pure, white and coarsely crystalline limestone, from Price's Creek, Rough Range, Kimberley; recorded as *Lonsdaleia* aff. *floriformis* in the Annual Report for 1923 of the Geological Survey of Western Australia p. 35, and as *Lonsdaleia* sp. cf. *L. floriformis* Mart. by Glauert, 1925, p. 45, Upper Devonian.



Text-figs. 6-8. ***Prismatophyllum brevilamellatum* sp. nov.**  
 2515, University of Western Australia, Holotype.  
 6. Transverse section.  $\times 1$ .  
 7 and 8. Median vertical sections.  $\times 1$ .

*Diagnosis*.—*Prismatophyllum* with short major septa, and with minor septa reduced to septal ridges.

*Description*.—The corallum is cerioid, and the corallites sub-equal and straight, of average diameter 0.8 mm. The largest corallite is 10 mm. in diameter. The type of increase of the corallum was not observed.

The septa are of two series, average number 18 of each, straight and not carinate; re-crystallisation masks the septal structure. The major septa are one-half to two-thirds the length of the radius, and are continuous plates, but the minor septa are reduced to mere septal ridges on the epitheca. The septa of neighbouring corallites tend to be placed opposite one another, usually major to major and minor to minor; and the wall between corallites thus has a serrated appearance.

The tabulae are complete, supplemented near the dissepimentarium by a few tabellae. They are shallowly concave, and on the average are 0.75 mm. apart, though this distance varies from 1.5 mm. to 8.3 mm.

The dissepimentarium extends half-way towards the axis. Dissepiments are in three or four irregular vertical series, are steeply inclined and rather shallow. Occasionally they show angular intersections in transverse section. There is no axial structure, and the skeletal elements are not dilated.

*Remarks*.—Only the holotype is known, and this is incomplete. The reduction of the minor septa to septal ridges, and the shallow concavity of the tabulae seem diagnostic structurally. It would seem to bear the same relation to *Prismatophyllum* as *Cylindrophyllum* Simpson does to *Disphyllum*.



## ALVEOLITES.

*Alveolites* Lamarek, 1801, p. 375.

*Alveolites*; Smith, 1933, p. 135.

*Alveolites*; Lecompte, 1933, p. 7.

*Genotype* (Genolectotype): *Alveolites suborbicularis* Lamarek, 1801, p. 376, Upper Devonian, Frasnian. Near Dusseldorf, Germany. Chosen Edwards and Haime (1850), p. lxi. See also Smith, 1933, p. 135.

*Diagnosis* (translated from the French of S. Smith, 1933, p. 135).—Massive Tabulate corals, growing in superposed layers. The corallites grow out horizontally or obliquely from one or more centres, the lower surface resting on the support. Usually the corallites are small, semilunar or subtriangular in section; they are more or less compressed, and open to the surface by oblique calices each with lower lip projecting. The wall may be thin or thickened; the septa when present are represented by spines. The tabulae are complete and thin, and the mural pores are wide and distant.

*Remarks*.—The genus has also recently been discussed by M. Lecompte, in a paper containing much valuable detail. He describes fully the variation possible in each species, and indicates the interpretation to be placed on sections taken along different directions in the corallum. He also compares the genus with *Favosites*, *Coenites*, and *Pachypora*.

*Arrangement of the calcareous fibres in the sclerenchyme*.—The walls of the corallites consist of fibres. They are arranged on either side of the median or sub-median planes of each wall, the plane appearing in thin section as the "median dark line." The fibres are slightly curved, being directed distally and towards the axes of the corallites. The plane is usually median in the more erect or polygonal corallites, and sub-median, nearer to the lower surface of the wall, in reclined and depressed corallites. If one considers the fibres of one corallite, *i.e.*, those on one side only of the median planes of the walls, it is seen that at certain points a small group of fibres is produced further in to the lumen of the corallite, forming a spine; such a spine may have its fibres radiating from its axis, as in the monacanth and holacanth of Rugose corals. The spines tend to be arranged in vertical series, each series thus being similar to the septum of a Rugose coral. Sometimes in the walls the growth lamination, which cuts the fibres at right angles, is more obvious than the fibres, owing to re-crystallisation, as in *Pachypora lamellicornis* Lindström.

Presumably the common walls of corallites were laid down in vertical invaginations in the base of the polypary, deposition of fibres being influenced by very shallow secondary invaginations (septal invaginations), on each side of the wall invagination. See diagram of the relation of the soft parts of a corallum to the hard parts, Hill (1936).

***Alveolites multiperforatus* Salée.**

*Alveolites multiperforatus*: Salée ms. 1915-16; Lecompte, 1933, pp. 39, 42, pl. iii., figs. 1, 1a, 1b; from the Middle Frasnian (F<sub>2</sub>), Assize de Frasnès, à *Hypothiridina cuboides*, on the southern border of the Dinant basin, the northern border of the Namur basin, and the flanks of the Condroz ridge.

*Diagnosis*.—Massive or encrusting *Alveolites* frequently of irregular growth; where growth is regular the corallites may be only 40-20° from the



vertical; the calicinal diameters are usually equal and polygonal corallites are predominant; locally in the corallum the walls are thickened; mural pores are abundant and not limited to the two side walls; spines may be present, variable; tabulae are straight and thin.

*Remarks on the Belgian specimens.*—The corallites have a diameter of approximately 1 mm.; compressed corallites occur locally. The common walls may be 0.5 mm. thick. Thickening of the wall does not exceed 0.25 mm., and the corners of the polygon may be rounded. The pores are usually 0.2 mm. in diameter, and about 0.66 mm. apart. Spines are occasionally present; there may be one only, median and strong, or numerous small radial ones, usually short and swollen, rarely long and thread-like, with sometimes one or two predominating.

*Description of a West Australian specimen, Alveolites aff. multiperforatus* Salée. (Plate I, figs. 9 and 10).—This is a worn fragment,  $1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{2}$  inches,  $\triangle$  43 in the Collection of the West Australian Museum, labelled *Favosites goldfussi* M. Edwards and Haime from (?) Champion Bay (? Gascoyne River). So far as is known there is no outcrop of Devonian rocks in Champion Bay, or along the Gascoyne River; but the lithology suggests that the specimen is from the Devonian opposite Mt. Krauss, in the Rough Range, Kimberley District. It is worn so that the calices and the shape of the corallum are not discernible.

The corallites of the fragment show at least one axis of divergence near which they are almost vertical; more distant corallites are increasingly more oblique (Plate I, fig. 10). Nearly all the corallites are polygonal, with a diameter of just under 1 mm.; rarely, very slightly compressed corallites are seen. The common walls are regularly about 0.4 mm. thick, usually a little more at the angles; their structure is that described above for the genus. The "dark line" is median. The walls are pinnately fibrous, with the fibres directed upwards and inwards. Mural pores are about 0.2 mm. in diameter, and about 0.7 mm. apart, and very numerous. They are not confined to the two side walls, but occur with equal frequency on all walls. Spines are seen in nearly all corallites, partly masked by re-crystallisation, in irregular vertical series, on any side of the corallite, or sometimes in the angles. They are of equal size, and about 0.17 mm. long. The maximum number observed in the transverse section of any one corallite was 8. The tabulae are thin, complete, straight or slightly arched, and there are usually 25 in the space of 10 mm.

*Remarks on the Australian fragment.*—The similarity of this fragment to *A. multiperforatus* was pointed out to the author by M. Lecompte. It shows constant thickening of the walls. This is a localised character in *A. multiperforatus*, but the Australian fragment may well be such a localisation in a large corallum. M. Lecompte also stated that Dr. Stanley Smith had shown him a specimen from the Frasnian of Canada which might well be called *A. multiperforatus*, so that the group would seem to have a wide geographical range. It is unfortunate that the locality of the West Australian specimen is so obscure.



**Alveolites tumida** Hinde.

(Plate I, figs. 11-14.)

*Pachypora tumida* Hinde, 1890, p. 197, pl. viii., fig. 3, Devonian, opposite Mt. Krauss, Kimberley District.

*Pachypora tumida* Hinde; Glauert, 1910, pp. 78, 83; 1925, p. 48.

*Pachypora tumida* Hinde; Hosking, 1933, p. 68.

*Holotype* (by monotypy): R. 2271 and 2 slides, British Museum; Devonian, opposite Mt. Krauss, Kimberley District.

*Description*.—The holotype is a fragment, 4 cm. long, 1.5-3.5 cm. wide and 1.3 cm. deep, from a tuberoso corallum. It looks like a fork between two branches; but growth was very irregular, for one "branch" grows downwards in relation to the corallites of the other (Plate I, fig. 11). In the "branch" which has been sectioned the corallites are arranged about one axis of divergence; the oblique calices suggest that at least at its periphery the branch is made up of sheaths of corallites arranged like the tobacco leaves in a cigar. The calices (Plate I, fig. 12) are oblique to the surface (not perpendicular thereto, as in *Pachypora* and *Striatopora*) and variable in outline. They are sometimes elongate with the lower lip projecting, when they may be semilunar, or nearly rhomboid when the corallite edges of the upper lip lie along the tops of the domed upper lips of the two underlying corallites. They are more usually irregularly polygonal or almost circular.

The corallites are about 1 mm. along their largest diameter (Plate I, figs. 13-14); they are usually hexagonal or almost circular in section, but, near the calices, may be depressed, semilunar or rhomboid; in the more cylindrical parts of the corallum they are arranged about axes of divergence; they leave the axis at an angle of  $30^{\circ}$  and curve gently towards the periphery, where they open obliquely. The walls between corallites are much dilated—0.03 mm.; they are pinnately fibrous, as described above for the genus, the fibres being directed upwards towards the axis of the corallites from a sub-median "dark line"; mural pores are rare and large (0.02 mm.). Occasional spines are present, and thin complete tabulae are developed.

**Aulopora repens** (Knorr & Walch); Hinde.

*Aulopora repens* (Knorr & Walch); Hinde, 1890, p. 199, from Rough Range, Mt. Krauss, Kimberley District, Western Australia. The specimen figured by Hinde is R. 2267 in British Museum.

Nothing can be added to Hinde's description, p. 199. "There is a single example of this species growing on the surface of *Cyathophyllum virgatum*, which, as far as its outward characters are concerned, cannot be distinguished from the type forms of the species from the Eifel. The corallites range from 2.5 to 4.5 mm. in length, and from 1 to 1.25 mm. in thickness. The oval or elliptical apertures are between .75 mm. and 1 mm. in width."

**SYRINGOPORA.**

*Syringopora* Goldfuss, 1826, pp. 75-76.

*Genotype*: (Genolectotype, see Edwards and Haime (1850) = *Syringopora ramulosa* Goldfuss, from the Carboniferous of Olne in Limburg, Germany. "Edwards and Haime give *Syringopora* as a synonym of *Harmodites* Fisher, 1828 (which however was published two years later), and take *S. ramulosa* as the genotype of *Harmodites*, thereby implying that they consider it the genotype of *Syringopora*" (Lang and Smith MS).

*Diagnosis*.—Fasciculate tabulate corals with long, thin, parallel to remotely diverging tubular corallites, connected by small approximately



horizontal tubules containing extensions of the tabulae. The septa are holacanthine. The tabulae are infundibuliform and axially connected to form an axial tube which may be crossed by horizontal plates. Increase is lateral.

*Arrangement of the calcareous fibres.*—The corallites of *Syringopora* have a peripheral stereozone which, in thin section often appears to be divisible into outer and inner zones, which, however, merge into one another. The outer zone is seen to consist of fibres directed inwards and slightly upwards. The inner zone is of wavy laminae very steeply inclined from the periphery down towards the axis, at right angles to the fibres of the outer zone. Set in this inner zone are vertical series of spines which are fibrous; the fibres are directed distally and outwards from the axes. The laminae arch up about the spines, and altogether this inner zone is similar to the stereozone of *Tryplasma rugosum*, which has been already described in detail (Hill, 1936). The spines are holacanthi; and the lamellar appearance of the sclerenchyme surrounding them is due to re-crystallisation having emphasised its growth lamination at the expense of its fibrosity. Each lamina really consists of fibres at right angles to its surfaces, and represents horizontal tissue laid down between the septa. Probably the fibres of the outer zone are merely the peripheral extensions of these fibres, but are not affected by re-crystallisation in the same way.

Thus the septa of *Syringopora* are holacanthine.

### *Syringopora patula* Hinde.

(Plate I., figs 15 and 16.)

*Syringopora reticulata* var. *patula* Hinde, 1890, p. 198, pl. viii., fig. 4, from the Gascoyne River (locality challenged). ? Devonian.

*Syntypes*: 10054, Geological Survey Collection, Western Australia, figured Hinde, 1890, pl. viii., fig. 4. This has a green paper spot, similar to those used in the British Museum to indicate figured specimens (Plate I., figs. 15 and 16). R. 2265, British Museum, from the Gascoyne River.

*Lectotype*: (here chosen), 10054, Geological Survey Collection, Western Australia (Plate I., figs. 15 and 16).

*Diagnosis.*—*Syringopora* with slightly diverging corallites of average diameter 2 mm., unevenly spaced and connected at irregular intervals chiefly by lateral contact of the walls, but also by connecting processes; lateral increase is frequent; spinules are short, and there is a persistent axial tube.

*Description.*—The corallum is fasciculate, in low bushy masses of slightly divergent flexuous corallites. The largest specimen examined was 5 cm. high by 11 mm. wide. The corallites range in diameter from 1.6 to 2.15 mm., and are at irregular distances apart, varying from 0.5 to 3 mm. Distally they diverge gently. Neighbouring corallites may come into contact laterally by their walls touching, or are connected by rather rare irregularly spaced connecting tubules. New corallites arise by frequent lateral increase. At their point of issue they are very narrow and are almost perpendicular to the parent corallite; then they quickly swell to the adult diameter and grow almost parallel to the proto-corallite; the narrow tube connecting the new corallite to the parent corallite is thus different in origin from the rarer connecting tubules.

The corallites have uniformly peripheral stereozones about 0.25 mm. thick consisting of "lamellar" sclerenchyme; the septal spinules, which are



holacanth, are very irregularly developed as small, conical projections from the inner surface of the stereozones. The tabulae are dissepiment-like plates, flat at the periphery, but becoming steeply inclined towards the axis, where they meet to form rather persistent axial tubes about 0.4 mm. in diameter.

*Remarks.*—Hinde erected this species as a variety of *S. reticulata* Goldfuss, from the Carboniferous. In its slightly diverging corallites and frequent lateral increase, however, it resembles more closely the Eifelian *S. caespitosa* Goldfuss, and I think that most probably it is Devonian in age. In matrix and preservation it resembles the corals from opposite Mt. Krauss, Rough Range, Kimberley, and in all probability it was really collected from that locality.

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## EXPLANATION TO PLATE I.

All figures (except figs. 11-14) x 2 diameters.

- Fig. 1. *Disphyllum virgatum* (Hinde), median vertical section of lectotype.
- Fig. 2. The same, transverse section of syntype  $\Delta$  4.
- Fig. 3. The same, vertical section of syntype  $\Delta$  4.
- Fig. 4. *Disphyllum depressum* (Hinde), median vertical section of syntype R. 13982.
- Fig. 5. The same, transverse section of syntype R. 13982.
- Fig. 6. The same, transverse section, part of holotype 10039.
- Fig. 7. The same, median vertical section, part of holotype 10039.
- Fig. 8. The same, median vertical section of 2754, University of Western Australia.
- Fig. 9. *Alveolites* aff. *multiperforatus* Salée, transverse section  $\Delta$  43.
- Fig. 10. The same, vertical section,  $\Delta$  43.
- Fig. 11. *Alveolites tumida* Hinde, external of holotype, natural size.
- Fig. 12. The same, x  $2\frac{1}{2}$ .
- Fig. 13. The same, transverse section, natural size.
- Fig. 14. The same, tangential section, natural size.
- Fig. 15. *Syringopora patula* Hinde, transverse section of the holotype.
- Fig. 16. The same, vertical section.

I am indebted to the British Museum of Natural History for the photographs figs. 11-14.





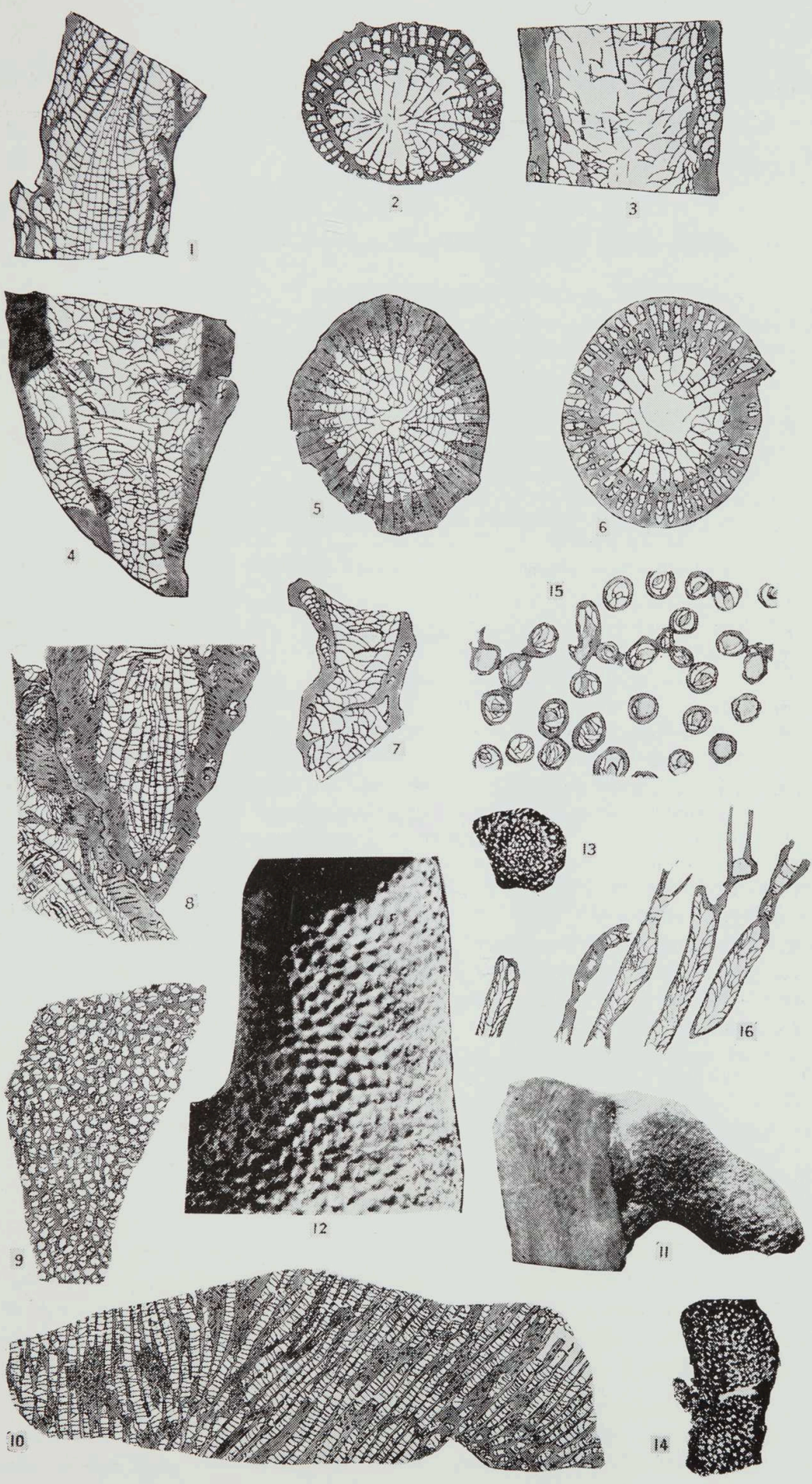


Plate I.